



# The function of the crab shell powder as calcium supplementary in the treatment of rickets

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**Background:** Rickets is one of the most common childhood diseases which suppress the growth and development of children if we don't treat it on time. Calcium also plays the important roles with the vitamin D, thus various kinds of calcium supplements are being developed and used in recent years. The crab shell powder has plenty of calcium and phosphate ( $16.39\% \pm 0.03\%$ ,  $1.72\% \pm 0.004\%$ ) and the rate of absorption is high. In addition, it contains several kinds of amino acids and microelements such as lysine which is essential to the growth and development of children. The crab shell powder is rich in source, the cost price is cheap and also easy to produce. We did research on treating children who are suffering from rickets with crab shell powder that we have described above. To estimate the effect of treatment for rickets by using crab shell powder.

**Methods:** We applied calcium lactate and crab shell powder to 105 children who are suffering from the rickets and observed the serum concentrations of calcium, phosphorus, alkaline phosphatase (ALP) and so on before and after the treatment. We have estimated the changes of the calcification plate and epiphyseal line before and after treatment according to the X-ray tests of wrist bones.

**Results:** The concentrations of the serum calcium and phosphorus had increased significantly while the concentration of the serum ALP had decreased after treatment. There were no significant differences between the study and contrast groups. The results of X-ray tests of wrists had shown that the healing rates of study and contrast groups were 94.3% and 93.3% each and significant differences had not been recognized.

**Conclusions:** The effective ratio of calcium lactate and crab shell powder in treatment for rickets had no difference, but crab shell powder markedly decreased the incidence of concomitant disorders compared with calcium lactate.

**Keywords:** Rickets; crab shell powder; calcium; vitamin D

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## Introduction

Rickets is the metabolic disease occurring from the disorders of calcification in the growing bone.

It develops generally by lack of vitamin D, as well as lack

of calcium intake.

The most common causes of rickets are not only deficiency of vitamin D but also that of calcium intake. Investigators refer that calcium intake is essential in treatment for rickets and the use of vitamin D help to

**Table 1** Change of serum calcium and phosphorus concentration ( $\bar{x}\pm SE$ , mg/dL)

Groups	Serum calcium concentration		Serum phosphorus concentration	
	Preadministration	Postadministration	Preadministration	Postadministration
Study group (n=55)	8.92±0.26	9.71±0.32 <sup>*</sup>	3.89±0.38	5.63±0.48 <sup>**</sup>
Control group (n=50)	8.94±0.32	9.74±0.21 <sup>*</sup>	3.88±0.35	5.62±0.46 <sup>**</sup>

<sup>\*</sup>, P<0.05 compared with pre-administration; <sup>\*\*</sup>, P<0.01 compared with pre-administration.

**Table 2** Change of serum ALP concentration ( $\bar{x}\pm SE$ , IU/L)

Groups	Serum ALP concentration	
	Preadministration	Postadministration
Study group (n=55)	213.11±14.08	155.82±13.27 <sup>**</sup>
Control group (n=50)	214.68±14.01	158.96±13.62 <sup>**</sup>

<sup>\*\*</sup>, P<0.01 compared with pre-administration.

promotes calcium intake (1-6).

Vitamin D and calcium intake play an important role in the treatment of rickets, thus various kinds of calcium supplements are being developed and used (3,7-10).

Crab shell powder is rich in various protein and amino acids as well as calcium and chitin, so that it has the effects of anti-rickets and bifidobacterium bifidus proliferation, infection suppression and so on.

Especially crab shell powder has chitin which is good for the improvement of the immunological, digestive and absorptive function of the organism and is effective for several diseases such as the ones of cardiovascular system.

We observed that Crab shell powder is rich in calcium and phosphorus (16.39%±0.03%, 1.72%±0.004%, respectively).

In addition, there are various amino acids and microelements including lysine that are good for the growth of children.

It is easy and cheap to produce Crab shell powder.

We conducted our research to apply crab shell powder, the natural origin, which has high resources and simple processes, for the treatment of children's rickets.

## Methods

### Materials

- ❖ Crab shell powder (CSP). Crab shells should be cleaned by sterilized water several times, cooked at steam of 100 °C for half an hour (30 minutes), dried and

pulverized as 50~100 μM of granules;

- ❖ Calcium lactate. Dose of calcium lactate 1 tablet is 0.25 g.

### Objects

- ❖ Study group (n=55): CSP 3~5 g (orally) (divided by 3~4 times a day). (Crab shell powder contains 16.4% of calcium and daily intake was calculated into 500~800 mg);
- ❖ Control group (n=50): calcium lactate 0.75 g (orally divided by 3 times a day).

### Experiments

We studied 105 children with rickets aged from 6/12 to 2.

We administered the doses to two groups for 3 months according to severity.

300,000 IU of vitamin D<sub>3</sub> was injected both in study and control groups.

All patients were tested for the serum concentrations of calcium, phosphorus and ALP (alkaline phosphatase), and wrist X-ray was taken in pre-administration and post-administration.

At the X-ray test we observed the changes of the wrist bone i.e., the changes of calcification plate and the epiphyseal line.

### Evaluation of therapeutic effect is as follows

- ❖ Healed; nervous symptom and other symptoms are all relieved and wrist X-ray showed obvious calcium accumulation in calcification line;
- ❖ Improved: among nervous symptom and other symptoms, only 1~2 clinical manifestations remain and wrist X-ray showed that calcium begins to accumulate in calcification line;
- ❖ Unchanged: nothing changed in both clinical manifestation and wrist X-ray.

**Table 3** Post-administration change of wrist X-ray findings (n)

Groups	N	Healed	Improved	Unchanged	Aggravated	Efficacy (%)
Study	53	23 (43.4)	27 (50.9)	3 (5.7)	–	94.3
Control	45	22 (48.9)	20 (44.4)	3 (6.7)	–	93.3

**Table 4** The overall result of treatment

Groups	N	Healed	Improved	Unchanged	Aggravated	Efficacy (%)
Study	55	25 (45.4)	27 (49.1)	3 (5.5)	–	94.5
Control	50	25 [50]	22 [44]	3 [6]	–	94.0

**Table 5** During treatment, incidence of various diseases

Groups	Number of patients	Episodes of various diseases		
		Diarrhea	Upper respiratory tract infection	Pneumonia
Study group	55	2 (3.6)**	11 [20]**	4 (7.3)
Control group	50	12 [24]	24 [48]	8 [16]

\*\* , P<0.01 compared with control.

And during study period we have observed the mortality of concomitant disorders such as diarrhea, upper respiratory tract infection, pneumonia and etc.

## Results

### *Post-administration change of serum calcium and phosphorus concentration*

Table 1 shows the post-administration changes of concentration of serum calcium and phosphorus.

Post-administration concentration of serum calcium has increased significantly compared with pre-administration in both groups (P<0.05), but significance between two groups are not recognized.

Post-administration concentration of serum phosphorus has increased significantly compared with pre-administration in both groups (P<0.01), but significance between two groups is not recognized.

### *Post-administration change of serum ALP concentration*

Table 2 shows the post-administration change of serum ALP concentration.

Post-administration concentration of serum ALP has decreased significantly compared with pre-administration in

both groups (P<0.01), but significance between two groups is not recognized.

### *Post-administration change of wrist X-ray findings*

Table 3 shows the post-administration change of wrist X-ray findings.

Post-administration efficacies of wrist X-ray findings have increased to 94.3%, 93.3% respectively and significance between two groups is not recognized.

### *The overall result of treatment*

Table 4 shows the overall result of treatment.

The efficacies of treatment for rickets have increased to 94.5% in study group, 94.0% in control group and significance between two groups is not recognized.

### *Occurrence of various diseases during study period*

Table 5 shows the occurrence of various diseases during study period.

During the medication, some children had several concomitant diseases.

The incidence of diarrhea, and upper respiratory tract infection decreased in study group (P<0.01) compared to



**Figure 1** The retraction of the epiphyseal line, the metaphyseal fraying and cupping of the distal radius and ulna.



**Figure 2** The recovery of the epiphyseal line and cupping of the distal radius and ulna.

control group, the incidence of pneumonia decreased to 7.3% in study group compared to 16% in control group, but significance between two groups is not recognized.

## Discussion

Rickets is the metabolic diseases occurring from the disorders of calcification in the growing bone.

It develops generally by lack of vitamin D, as well as lack of calcium intake (Figures 1,2).

The most common causes of rickets are not only deficiency of vitamin D but also that of calcium intake. Investigators refer that calcium intake is essential in treatment for rickets and the use of vitamin D help to promotes calcium intake (1-6).

Vitamin D and calcium intake play an important role in the treatment of rickets, thus various kinds of calcium supplements are being developed and used (3,7-10).

Crab shell powder is rich in various protein and amino acids as well as calcium and chitin, so that it has the effects of anti-rickets and *bifidobacterium bifidus* proliferation, infection suppression and so on.

Especially crab shell powder has chitin which is good for the improvement of the immunological, digestive and absorptive function of the organism and is effective for several diseases such as the ones of cardiovascular system.

We observed that Crab shell powder is rich in calcium and phosphorus ( $16.39\% \pm 0.03\%$ ,  $1.72\% \pm 0.004\%$ , respectively).

In addition, there are various amino acids and microelements including lysine that are good for the growth of children.

It is easy and cheap to produce Crab shell powder.

We examined the function of the crab shell powder in the treatment of rickets.

The serum concentration of calcium and phosphorous increased significantly at post-administration than pre-administration ( $P < 0.05$ ,  $P < 0.01$ ) and the serum ALP has decreased significantly from  $213.11 \pm 14.08$  IU/L at pre-administration to  $155.82 \pm 13.27$  IU/L, thus there was no significant differences between study group and the contrast one.

This shows the crab shell powder differ little from the calcium lactate in the normal recovery of serum concentration calcium and phosphorous and the serum ALP.

Considering the changes of the wrist X-ray findings before and after treatment, the normal recovery children in the metaphyseal fraying and cupping of the distal radius and ulna or retraction of the epiphyseal line was 94.3% and 93.3% in the study group and the contrast group respectively, and no significant differences were recognized between them.

These results were the same with the preceding thesis (1-10) which says calcium intake and vitamin D are important in the treatment of rickets and it also shows the crab shell powder is calcium supplementary as calcium lactate in the treatment of rickets which has little differences with it.

The reason that the effective rate has not reached 100% is we did not consider low weigh baby and set 3 months of treatment period, not relating with the severity of rickets.

Total record was 94.5% in the study group and 94% in the contrast group and no significant differences were recognized.

During the period of the treatment of rickets, the

children might suffer from several disease such as diarrhea, upper respiratory tract infection and pneumonia, but mortality rate of diarrhea and the upper respiratory tract infection in the study group was low significantly than the contrast group.

Through research, we could find out the crab shell powder is effective as calcium supplementary and has good functions than the common calcium supplementary in the process of disease occurring often in the children.

Therefore, the crab shell powder is superior to calcium lactate in the treatment of rickets.

## Conclusions

Firstly, therapeutic effect of crab shell powder for rickets is high as 94.5%, and has no significant differences compared to control group—94% of calcium lactate.

Secondly, crab shell powder has markedly decreased the incidence of concomitant disorders (diarrhea, upper respiratory tract infection and etc.) compared to calcium lactate.

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## Footnote

*Conflicts of Interest:* All authors have completed the ICMJE uniform disclosure form (available at <http://dx.doi.org/10.21037/pm.2020.04.01>). The authors have no conflicts of interest to declare.

*Ethical Statement:* The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. Ethical approval was obtained for this retrospective case-control study was approved by the Pyongyang Medical College Hospital Ethic Review Committee (No. 2018-241).

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